

# SHIFT THE CURRENT AIR TRAFFIC MANAGEMENT PARADIGM: FROM MEANS TO OBJECTIVES MANAGEMENT

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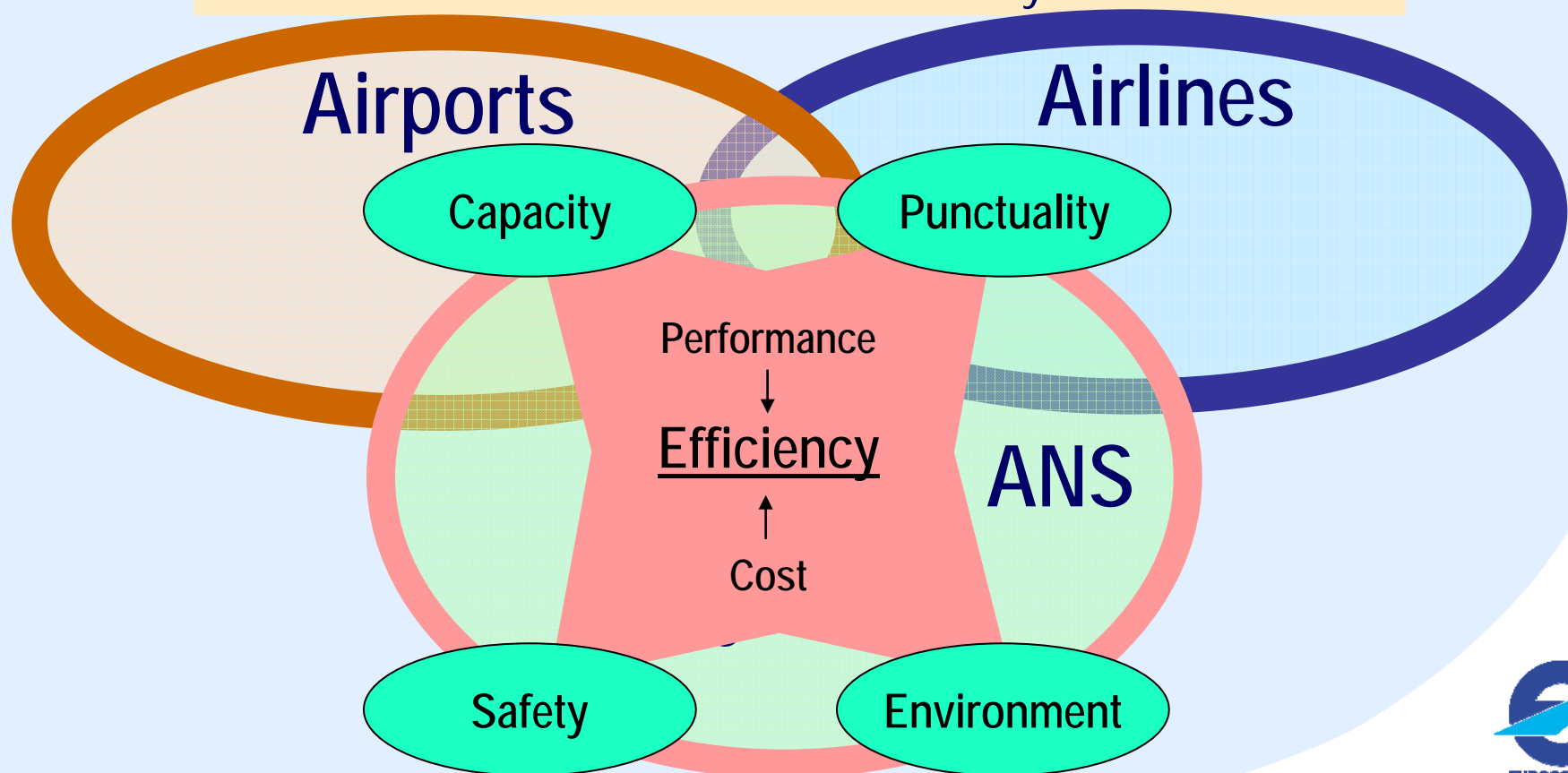
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Innovative Research  
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# Paradigm SHIFT project: Goals

To investigate a **new control paradigm** that could cope with **future air traffic demand** of the horizon **2020** and beyond.



# From Paradigm SHIFT Analysis

## Analysis

→ Different economical models, technical models, social models, ATC modes of operation ... will prevail according to actors (efficiency)

→ Coordinate different models (continuity, stability)

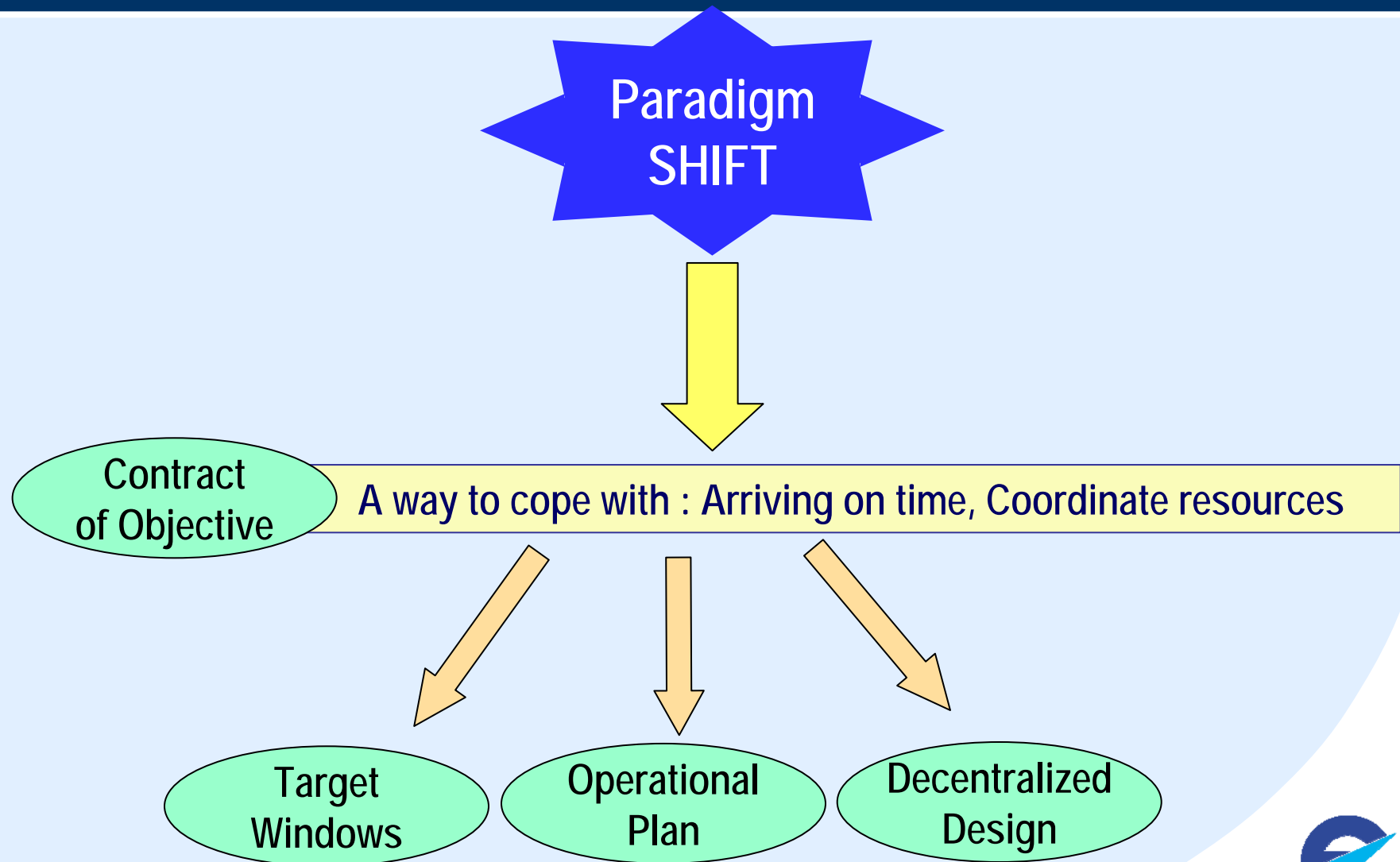
→ Each actor is responsible for his resources and knows his constraints (local efficiency for global optimisation)

→ Scarce resources: we need global coordinations and negotiations (objectives)

→ Aircraft, Runways, Gates, Controllers

→ System couldn't be totally anticipative (predictive?),  
we should keep a part of reactivity (human centred)

# From Paradigm SHIFT : a top down approach

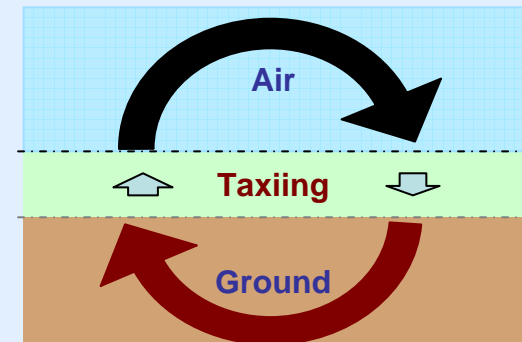


# Contract of Objectives

## Contract of Objectives

A way to cope with : Arriving on time, Coordinate resources

- ❑ Reconcile Ground and Air phases
- ❑ Link ATM actors together through agreed interfaces
  - ❑ Result of the negotiation phase involving all actors
- ❑ Define objectives applicable to flight
  - ❑ Integrate flexibility to cope with uncertainties (manage disruptions)



**The Contract of Objectives is the key element for the stability of the ATM system.**

# Contract of Objectives

## Contract of Objectives

A way to cope with : Arriving on time, Coordinate resources

- ❑ Objectives issued through a breakdown of **responsibility**
  - ➔ Seeking for the best organization at a local/lower level (best view of the reality)
  - ➔ In order to optimize resources

Planned what is feasible  
and  
Run what is planned  
through  
shared & negotiated Objectives

# Contract of Objectives

## Contract of Objectives

A way to cope with : Arriving on time, Coordinate resources

### ❑ The CoO : a Link between ATCOs

Interfaces between ATCOs are specified: clear Objectives and Responsibility

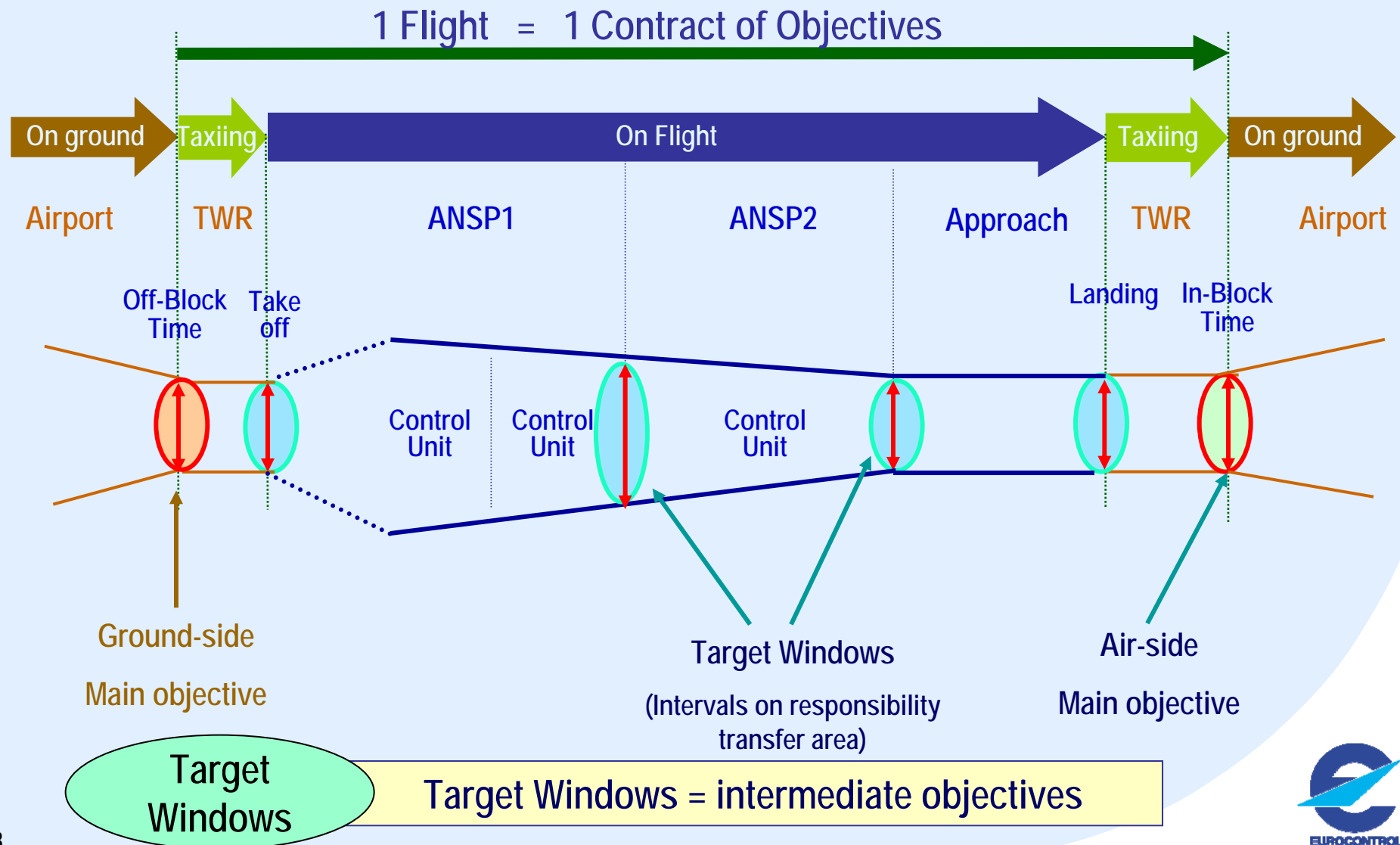
Evolution of the ATCOs working methods :

- ➔ Manage aircraft for safety first (like today)
- ➔ Manage the Performance of the system (punctuality) based on objectives

### ❑ The CoO : a link between ATCOs and Air-crew

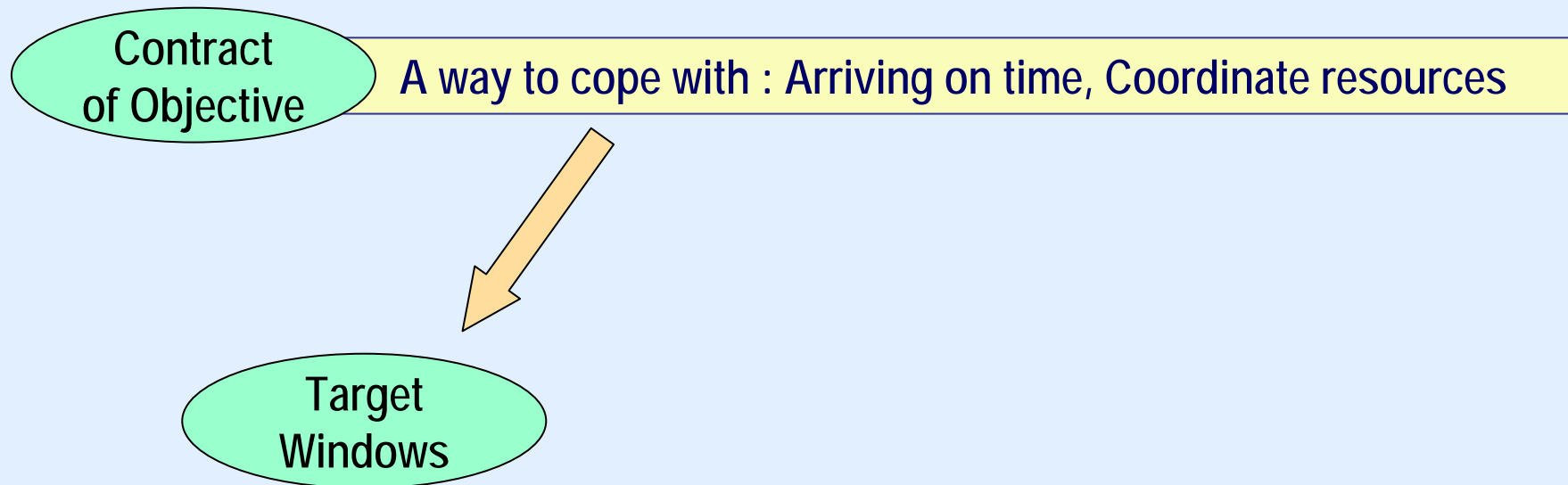
- ➔ Same vision and common objectives
- ➔ Responsibility sharing : Air-crew is no longer the only one responsible to achieve punctuality

# Contract of Objectives





# The Target Windows



# Target Windows

## Target Windows

A local representation of the global efficiency

- ❑ Intermediate objectives negotiated between actors
  - ❑ Create a link between planning and flight phase
  - ❑ Represent the responsibility transfer
  - ❑ Define milestones marking out traffic progress
- 
- ❑ Put constraints only when necessary

**From Means management  
to Participative Objectives  
management**

TW =      Global objective (arriving on time)  
              + local constraints  
              + disruption management

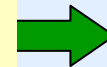
# Target Windows

## Target Windows

A local representation of the global efficiency

Integration of the different operational constraints

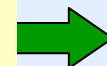
- ❑ Destination punctuality
- ❑ Technical capability (flight envelope, ...) and events
- ❑ Congested en-route area (bottleneck)
- ❑ ...



Organization, Efficiency

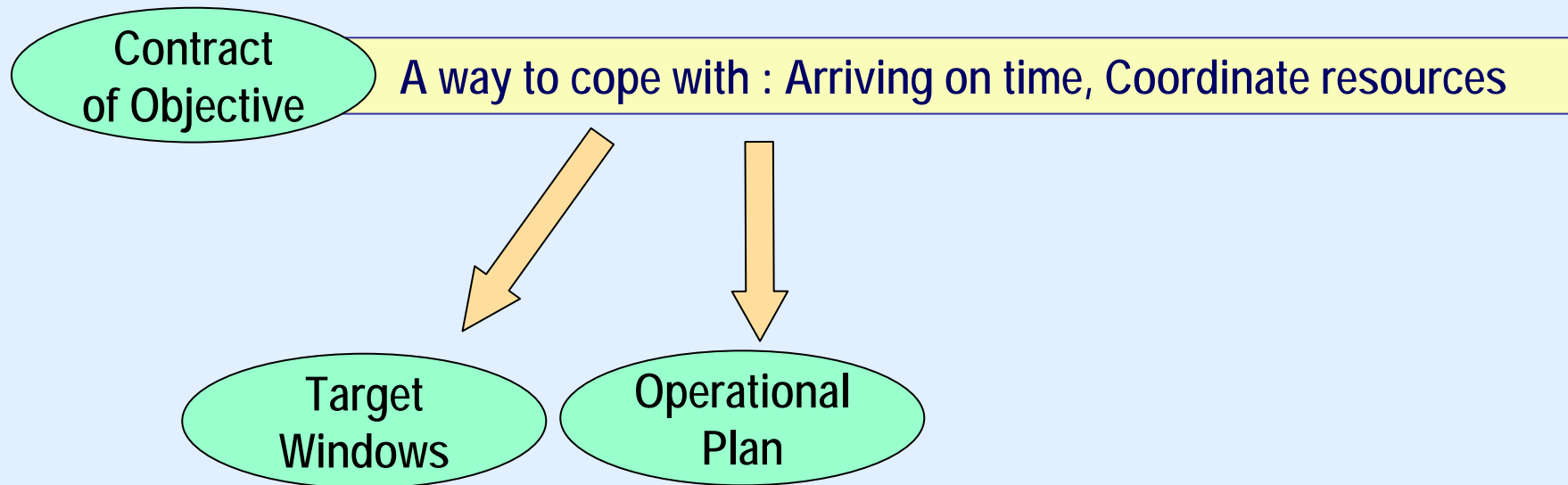
Open room of adaptation (limit chain reaction)

- ❑ To Contain residual uncertainty  
(disruptions management)
- ❑ To reduce impact on planning of action of Control on traffic



Resilience  
(reduce impact of  
uncertainty)

# The Operational Plan



# Operational Plan : ATM organization

## Organization around the Contract of Objectives

### Planning Phase

To Elaborate the Contracts of Objectives

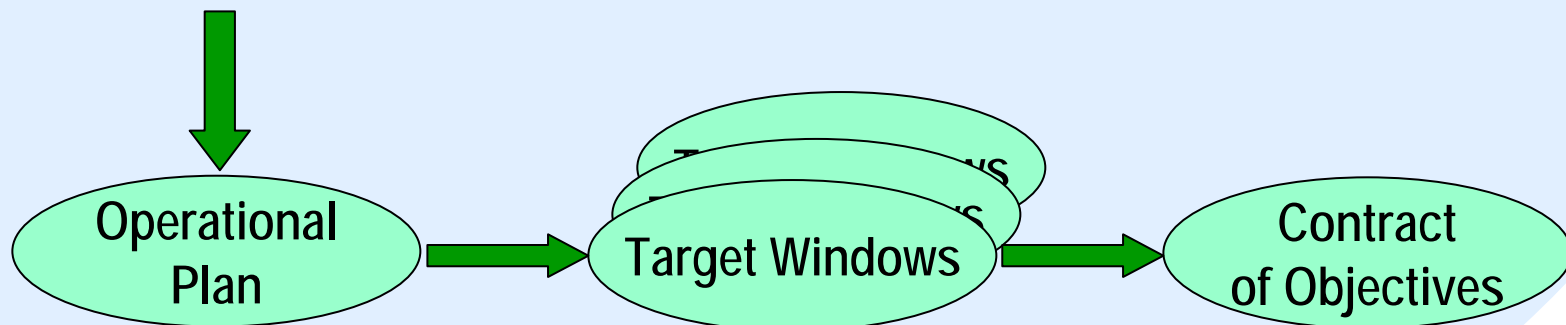
Need a decision-making process based on :

- ❑ Collaboration
- ❑ Granularity

### Flight Phase

To fulfill the Contracts of Objectives

To Renegotiate if necessary



# Operational Plan : Planning Phase

## Operational Plan

### A Process to build Contracts of Objectives

- ❑ Macroscopic approach rather than a temporal reference (granularity, responsibility)
- ❑ Refinement process : refining is better than redefining
- ❑ Collaborative & transparent mechanism involving all actors.
- ❑ Achieving agreement :  
from the expressed & agreed constraints of involved actors
- ❑ Integrate disruptions

**It should be made at a Strategic level**

**It is not a traffic regulation to protect from overloading the control function.**

**It is a coordination process between various actors based on their own constraints**

## 15



# The Flight phase : ATC

## Contract of Objectives

A way to cope with : Arriving on time, Coordinate resources

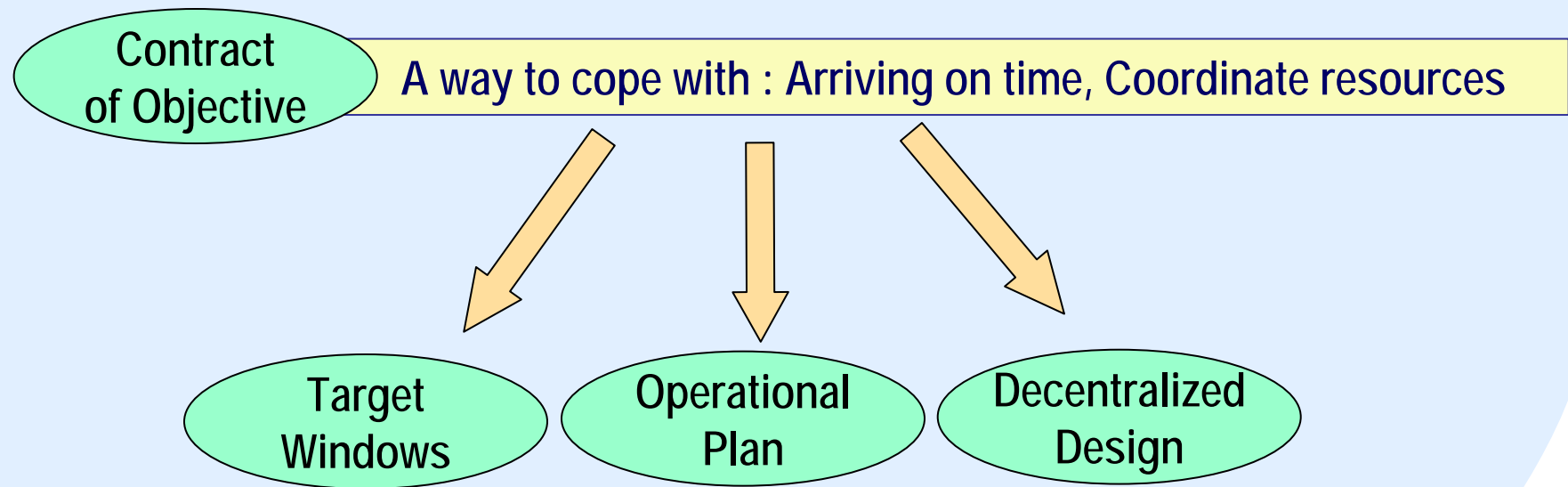
The goal is to **fulfill** the Contract of Objectives

If a Contract of Objective couldn't be achieved : **Renegotiation** at strategic level

- ❑ Allow best alternatives at a global level
- ❑ Ensure overall consistency (planned/reorganized operations)
- ❑ Need early detection
- ❑ Number of occurrences is a performance indicator
- ❑ Corrective post analysis



# Decentralized Design



# Decentralized Design

## Decentralized Design

A way to cope with non-homogeneity

### From Analysis

- ❑ Different models for ANSPs (economical, technical, ...)
- ❑ Different ATC modes of operations
- ❑ Flight demand non homogeneous (geographically, traffic topology, density by time)
- ❑ Need to optimise resources (Adapt local resource to demand)

### Proposition

- ❑ Decentralize the organization of the ATM to cope with these diversities

The Design (airspace, resources management ...)  
is given to responsible units (i.e.: ANSP)

# Decentralized Design

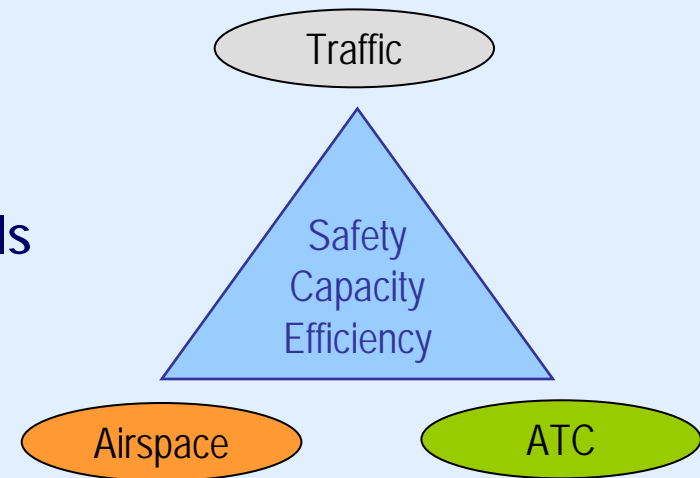
Decentralized  
Design

Organisation of En-Route resources by the ANSP

What is a local optimum ?

Tactical balance

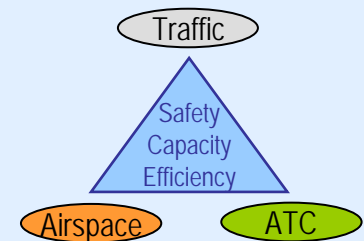
- Traffic
- Airspace
- ATC: controllers, working methods and tools



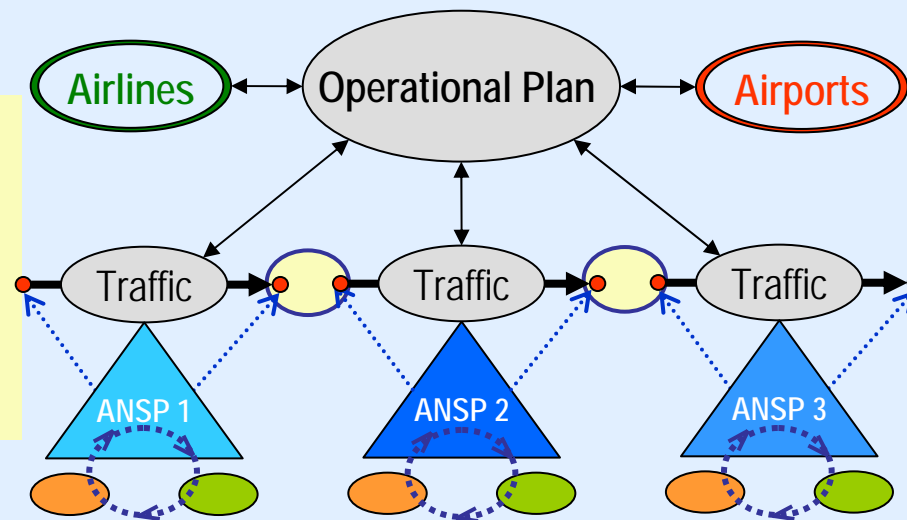
# Decentralized Design

## Decentralized Design

### Organisation of En-Route resources by the ANSP



We talk about  
traffic continuity  
by reaching an agreement  
on interfaces  
(Flights consistency)



To achieve  
Global efficiency  
By autonomous design  
and local organization

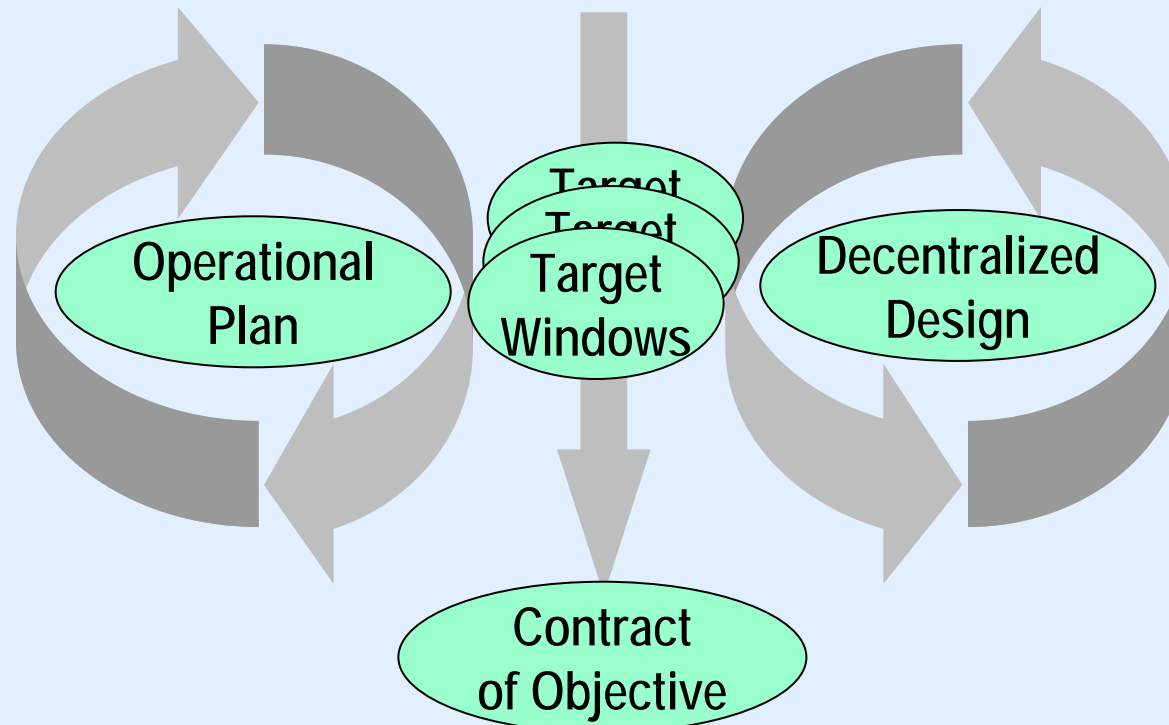
Decentralized Design =  
A refining local organization process based on traffic cooperation

# Summary

2 organizational processes linked by Target Windows

Global organization

Local organization



Planned what is feasible  
and  
Run what is planned  
through  
shared & negotiated  
Objectives

Signed Objectives who make  
the link between Planning and  
Flight phase

# Future works

- ❑ Study on impact of Target Windows on Controller Working Position (end of June)

- ❑ European Commission Project (4th Call of 6 FP)

CATS Project : Contract-based Air Transportation System

“Improving punctuality and efficiency through Contract of Objectives”

Partners:

- ❑ NeoMetSys
- ❑ EUROCONTROL Experimental Centre
- ❑ AirFrance Consulting
- ❑ CRNA Nord (French ANSP)
- ❑ UNIQUE (Zurich Airport)
- ❑ Leiden, Patras, Trieste Universities

# Paradigm SHIFT

## Questions ?

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